

# Energy Engineering Analysis Program

## Installation Energy Modeling using FEDS to Analyze Future Scenarios

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# FEDS Energy Assessment Goals

- ✓ Establish baseline for installation energy consumption and costs, including:
  - Building load analysis by end-use
  - Building energy use intensity (MMBtu/ft<sup>2</sup>)
  - Fuel consumption by building type
- ✓ Identify and prioritize cost-effective energy projects for funding via third-party financing (ESPC, UESC), and/or government funding (ECIP, OMA). Provide initial life-cycle cost analysis.
- ✓ Estimate impact on energy demand and consumption from building construction, demolition, renovation, utility modernization, O&M, and energy-specific retrofits.
- ✓ Assess impact of various scenarios for CEP operation, including partial or complete decentralization, building load reduction, co-generation, thermal storage, etc.



# FEDS Assessments Completed at Army Installations



# Facility Energy Decision System (FEDS)

## What is it?



FEDS is a fuel-neutral, technology independent, comprehensive method for quickly and objectively identifying building energy efficiency improvements that offer maximum savings



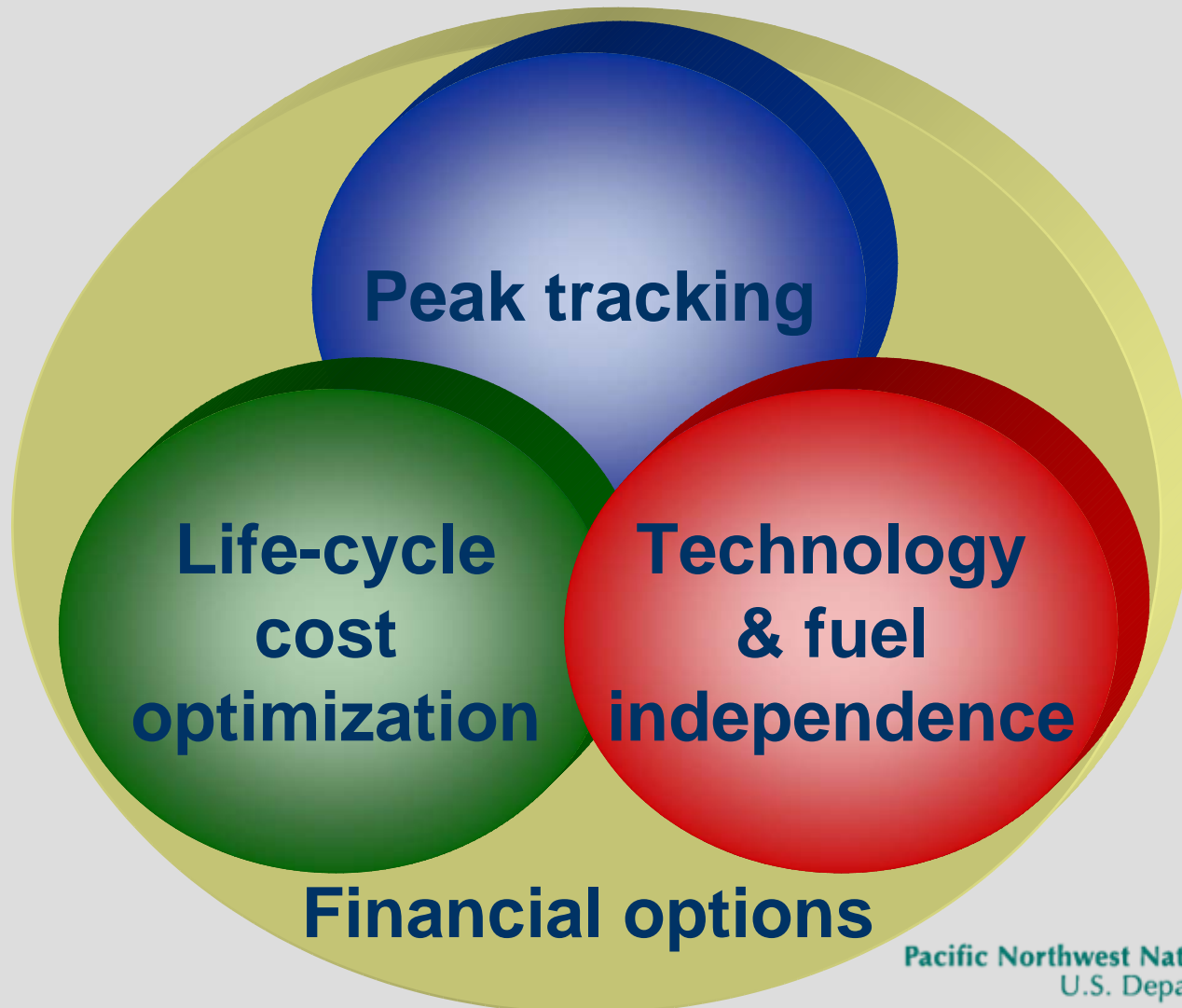
# FEDS Design Goals



- ▶ FEDS was designed with two major purposes in mind:
  - estimating current energy consumption for all energy systems under consideration
  - determining the minimum life-cycle-cost retrofits to systems within a facility and on an installation (considering all interactive effects) and includes estimating:
    - pre- and post-retrofit consumption
    - first cost of the retrofits
    - recurring O&M costs for the retrofits
    - value of the change in annual energy consumption, demand, and annual O&M requirements
    - net present value of the retrofits



# FEDS is **Unique**



# Life-Cycle Cost Optimization

- ▶ FEDS chooses the retrofit technology that provides the required service at the minimum life-cycle cost
- ▶ FEDS accounts for energy, demand, O&M, and replacement costs over the study period
- ▶ FEDS considers the interactions between building systems as well as between buildings



# Financing Options



## ► FEDS allows:

- Modification of project cost components
- Comparison of various financing mechanisms:
  - Appropriated or site funding
  - Utility or third-party loans
  - Leases
  - Energy Savings Performance Contracts (ESPC)





# Completely Updated Central Energy Plants and Thermal Loops Module

- ▶ FEDS 6.0 will now enable much more detailed specification and analysis of any number of central energy plants and their associated loops and can determine:
  - The total load from all connected buildings and other central plant equipment, both at baseline and throughout the retrofit optimization process
  - The value of steam, hot water, or chilled water delivered to each building, considering central plant equipment types and efficiencies, source fuel costs, auxiliary power requirements, O&M costs, loop losses, and other parameters
  - The cost effectiveness of various decentralization options including:
    - Which individual technologies served centrally should be replaced with distributed technologies,
    - Which building sets should be decentralized,
    - Which thermal loops of a central energy plant should be abandoned with all attached buildings becoming decentralized, and
    - Which central energy plants should be abandoned with all attached loops becoming abandoned and all attached buildings becoming decentralized
  - This central plant and thermal loop analysis occurs automatically in conjunction with optimization of building energy systems.



# Evaluating Scenarios Using FEDS

- ▶ Analyze fuel-switching
- ▶ Value “deals” (ESPC, UESC, future avoided costs)
- ▶ Assess impacts of change (New building construction, renovation, demolition, major upgrades to CEPs and thermal distribution systems, and energy-specific retrofit projects)
- ▶ Evaluate sustainable building designs
- ▶ Apportion reimbursable customers
- ▶ Central plant and thermal loop analysis (optimize amount of decentralization)
- ▶ Evaluate alternative technology applications



# Rock Island Arsenal Scenarios

- ▶ Implement all life-cycle cost effective retrofits for lighting, building envelope, HVAC systems, building-level boilers, and potable water
- ▶ Central Plant Options (to reduce the future replacement cost for the plant)
  - Optimize building insulation to reduce heating/cooling loads
    - Roof insulation only
    - Roof and wall insulation
  - Convert from steam to hot water for distribution system
  - Eliminate one complete distribution loop and provide heating/cooling with ground source heat pumps, gas-fired boilers, and infrared heaters



# Redstone Arsenal Steam Systems Options Study

## ► Baseline

- Status quo

## ► Short-term options (1-9 years)

- Option 2 – sell NASA summer steam at discount
- Option 3 – install new absorption chillers to use summer steam
- Option 7 – install building-level boilers to prune branches from steam system for winter shutdown

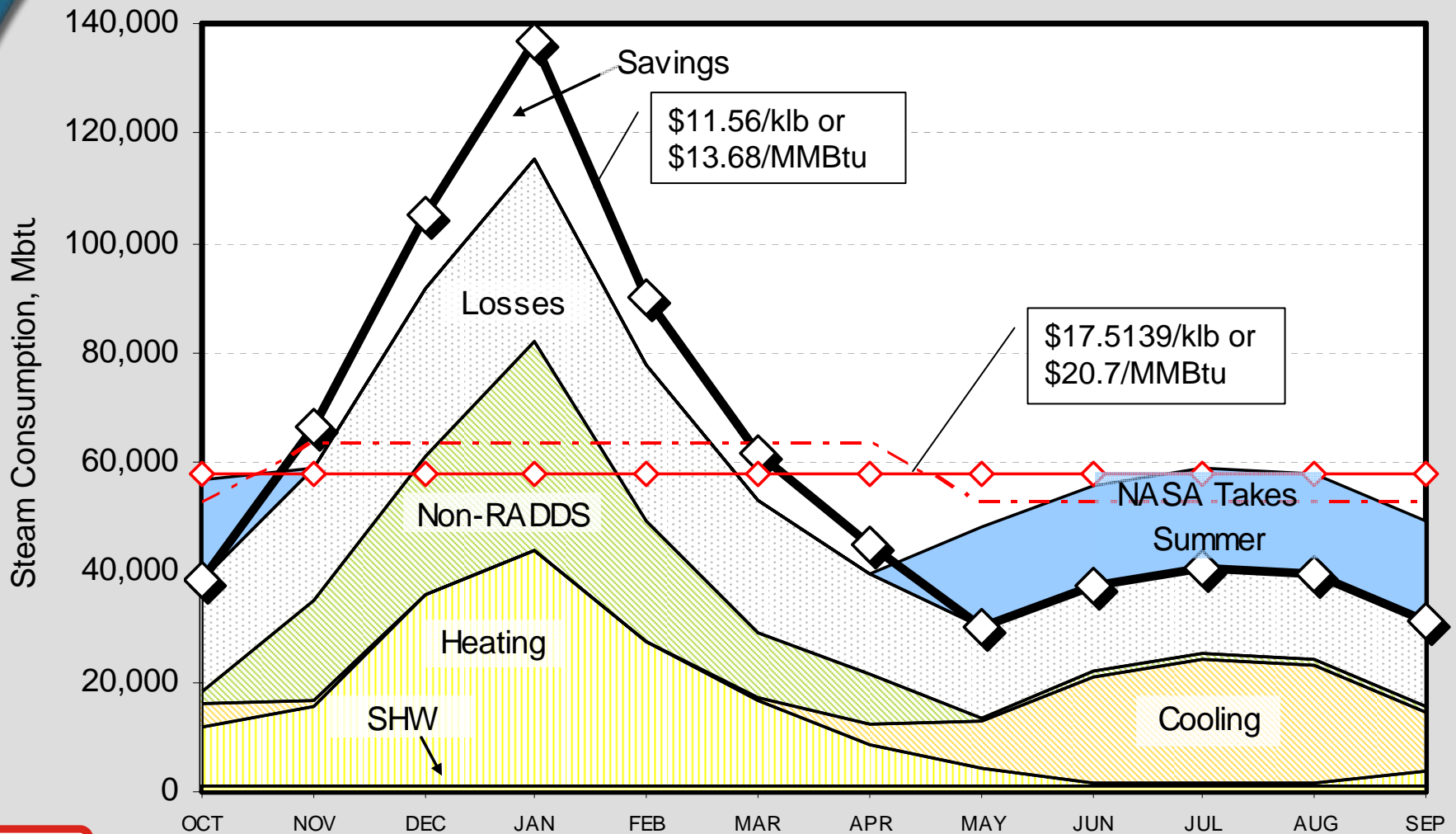
## ► Long-term options (10-25 years)

- Option 8 – continue on purchased steam at lower rate, using Option 7 pruning groups (year-round pruning) in years 10-25
- Option 9 – complete summer shutdown of steam system
- Option 10 – complete decentralization



# #7: Selected Winter Pruning

## FY2003 TMY Data



# Fort Jackson Scenarios

The following options were evaluated in this study:

- ▶ Continued operation of existing systems with periodic equipment replacements as necessary.
- ▶ The replacement of central boilers and hot water distribution piping with building boilers and natural gas piping.
- ▶ Central cogeneration of electricity and hot water.
- ▶ Self-generation of electricity for peak demand shaving.
- ▶ Central chilled water storage.



# FEDS Methodology

The assessment process includes:

- Collection of existing information on real property, central energy systems, energy consumption and prices, past energy projects, and planned infrastructure changes.
- Walk-through audits of selected representative buildings (25-30 buildings).
- Development of site energy model using the FEDS software and calibration of the model to match actual energy consumption.
- Site energy modeling and analysis to identify retrofit opportunities and provide initial life-cycle cost assessment.
- Prepare assessment report with detailed spreadsheet on all cost effective energy retrofit opportunities.



# Summary

- ▶ FEDS provides a baseline from which the cost effectiveness of various technology options can be measured.
- ▶ FEDS allows “what if’s” to be analyzed on a consistent basis.
- ▶ FEDS compares different funding/financing options and determines the order of magnitude investment requirements.
- ▶ Projects that are identified with FEDS normally require more detailed engineering analysis before submission as appropriated projects (ECIP, OMA, AWCf, etc.).

